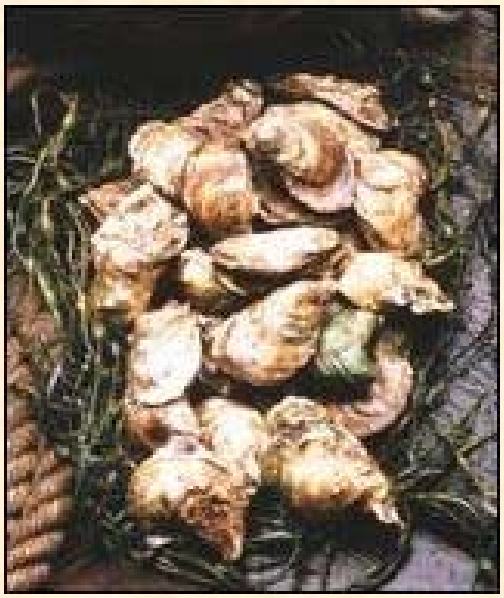
# *Cockrell Creek*
# *TMDL for Shellfish Waters*

Heathsville, VA



5 September 2007

# *What is a TMDL?*

TMDL = Total Maximum Daily Load = maximum amount of a pollutant that can enter a waterbody without violating water quality standards (WQS)

WQS = numeric or narrative limits on pollutants that ensure the protection of human health and of aquatic life

# *The TMDL Process in VA*

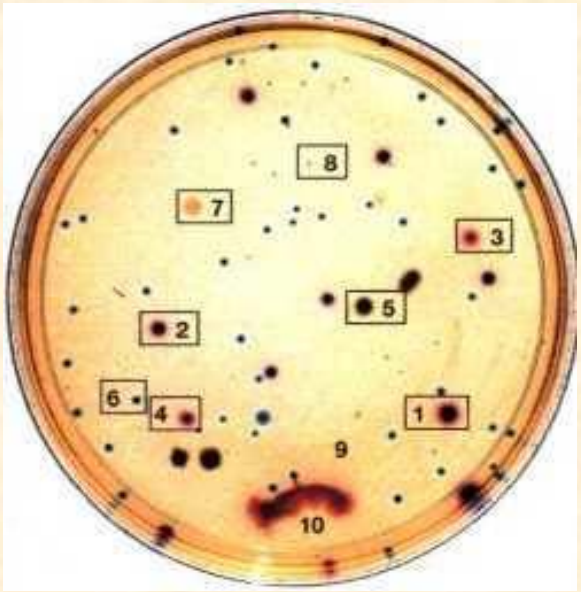
- Three Step TMDL Process in VA
  - TMDL Development (Find the source of the pollutant & determine the reduction needed)
  - Implementation Plan Development (Identify conservation measures to fix the problem. Conservation measures are often called Best Management Practices or BMPs.)
  - Implement the BMPs and sample to see improvement.

# ***Why a TMDL for the Cockrell Creek Watershed?***

- VDH Division of Shellfish Sanitation (DSS) monitors fecal coliform levels in shellfish waters
- Applicable water quality standard: 30-month geometric mean not exceeding 14 MPN/100 mL, and a 90th percentile not exceeding 49 MPN/100 mL
- Cockrell Creek has observed exceedances that necessitate TMDLs be developed to bring them into compliance

# *What are fecal coliform bacteria?*

- Bacteria present in the intestines of warm blooded animals, like livestock, wildlife, birds, and humans
- Indicator of the potential presence of pathogens in water



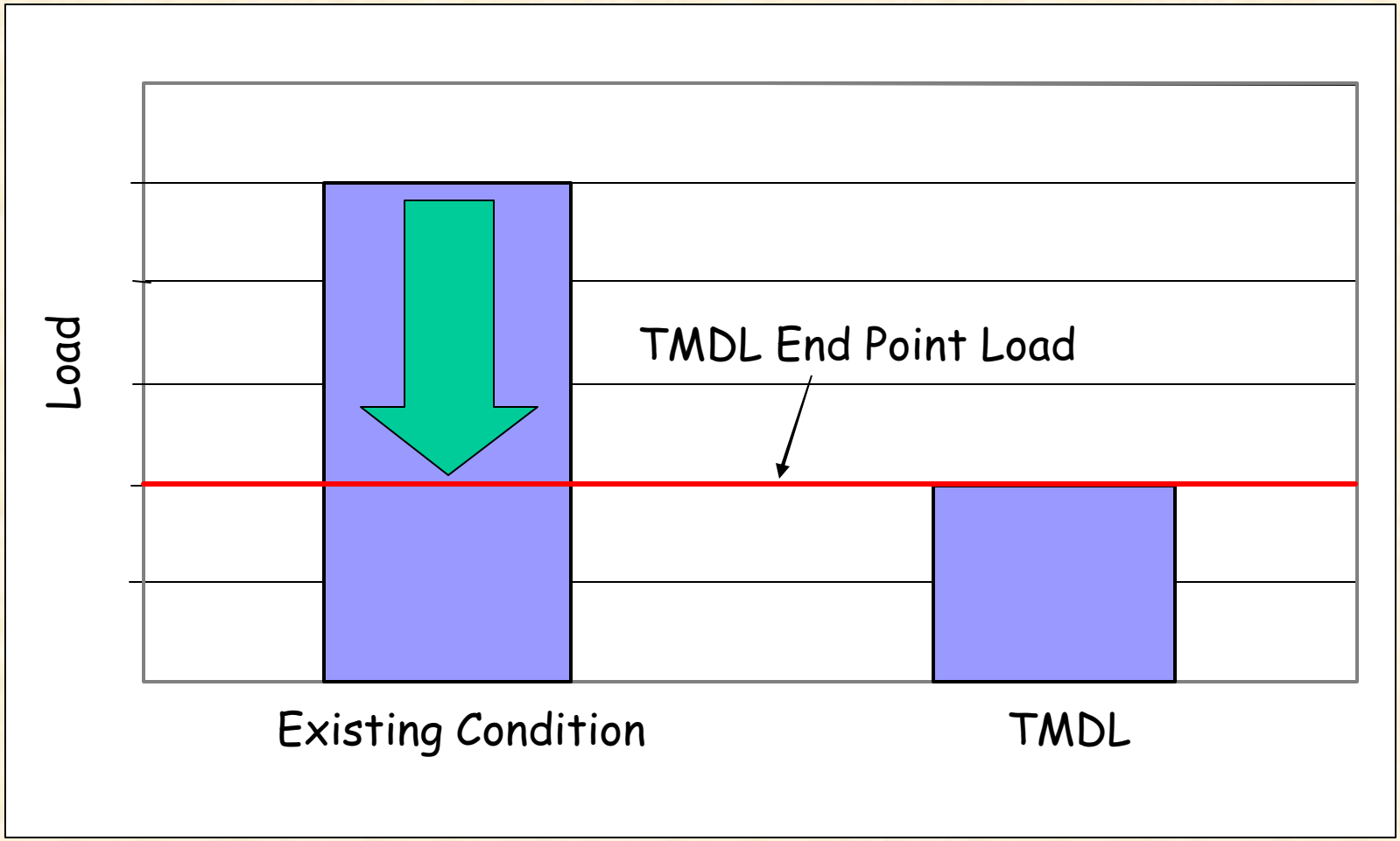
# ***Required Elements of a TMDL***

- Developed for critical stream conditions;
- Must meet water quality standards;
- Consider seasonal variations;
- Include wasteload and load allocations;
  - waste load = permitted human discharges
  - load allocation = loads due to wildlife, cattle, pets
- Include a margin of safety;
- Consider impacts of background contributions;
- Be subjected to public participation;
- Have reasonable assurance for implementation.

# What information might be used to develop a TMDL?

- VDH Sanitary Shoreline Survey
- VDH Bacteria monitoring
- Population estimates (human,pets,livestock)
- Affected waters volume
- Bacterial Source Tracking Data
- Land use, Climate, Tide and similar data
- DEQ permit data if applicable
- DEQ spill response and remediation data

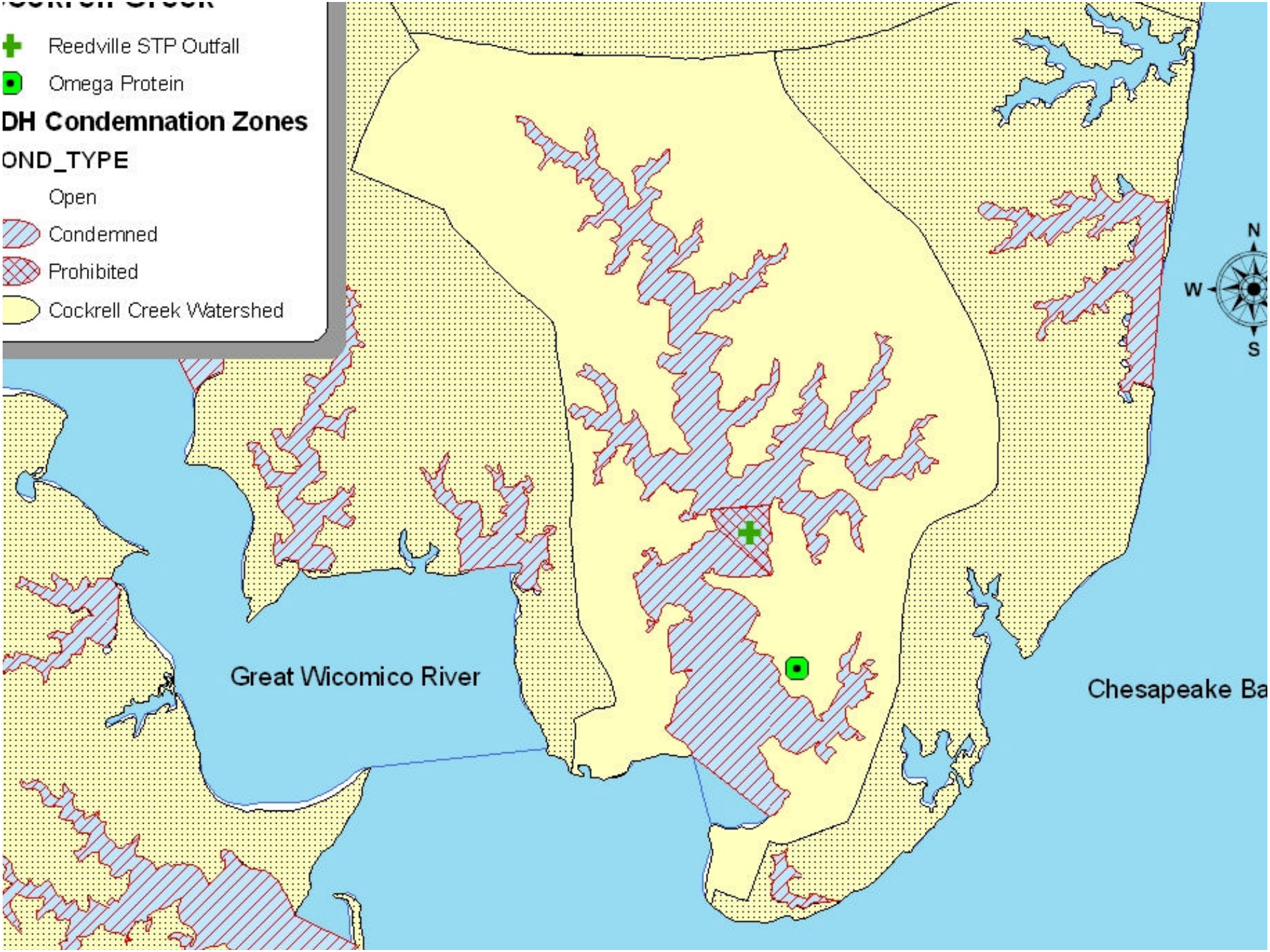
# An Example TMDL




**Reducing existing bacteria load to the TMDL end point load is expected to restore water quality.**

# What's changed since last year?

- New data
  - DEQ Special Study conducted from Aug 2006 – Feb. 2007
  - Revised data analysis
  - New studies and information incorporated into TMDL.


Reedville STP Outfall
Omega Protein
DH Condemnation Zones
OND_TYPE
Open
Condemned
Prohibited
Cockrell Creek Watershed
N
W
S
Great Wicomico River
Chesapeake Ba

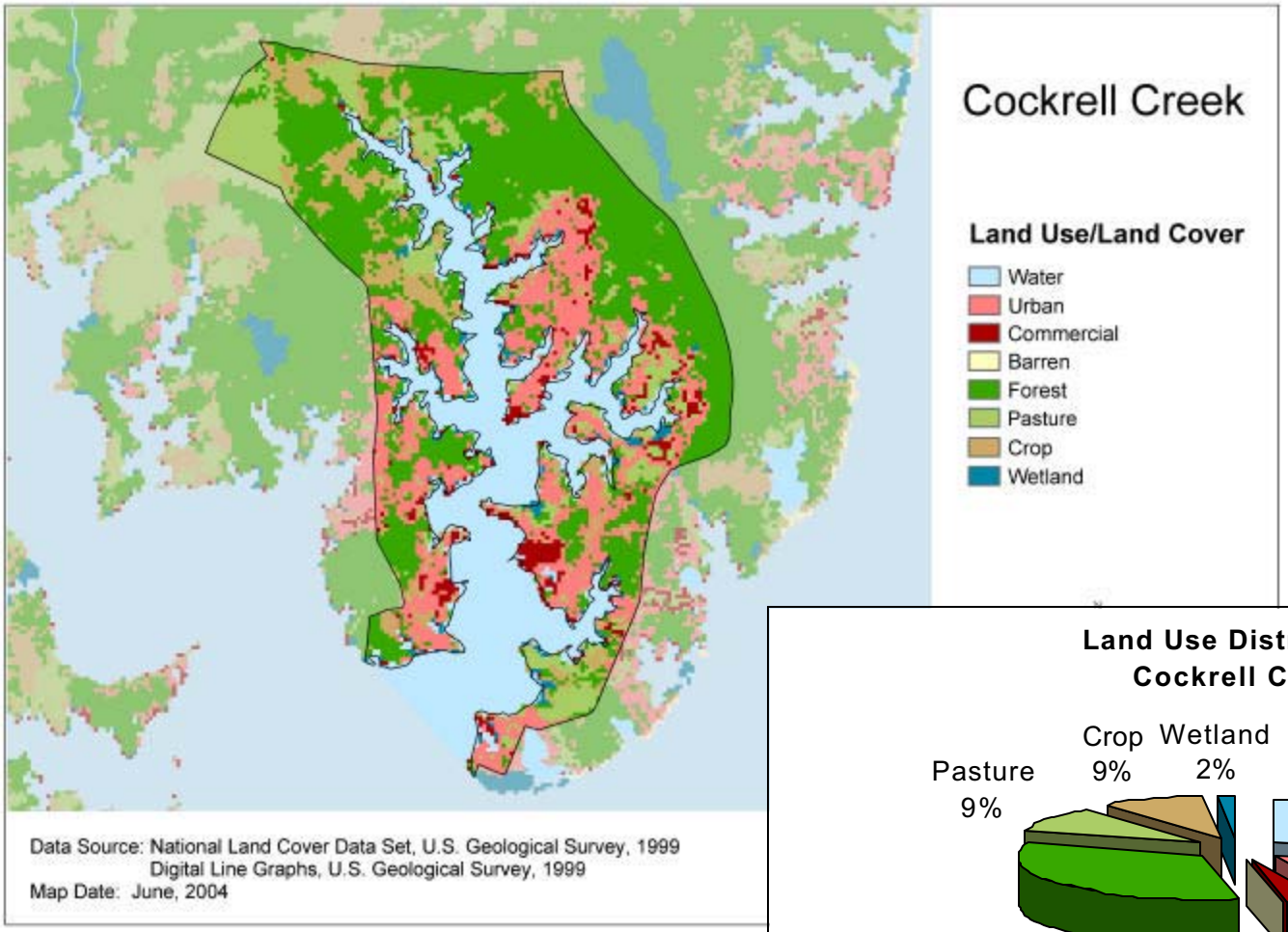
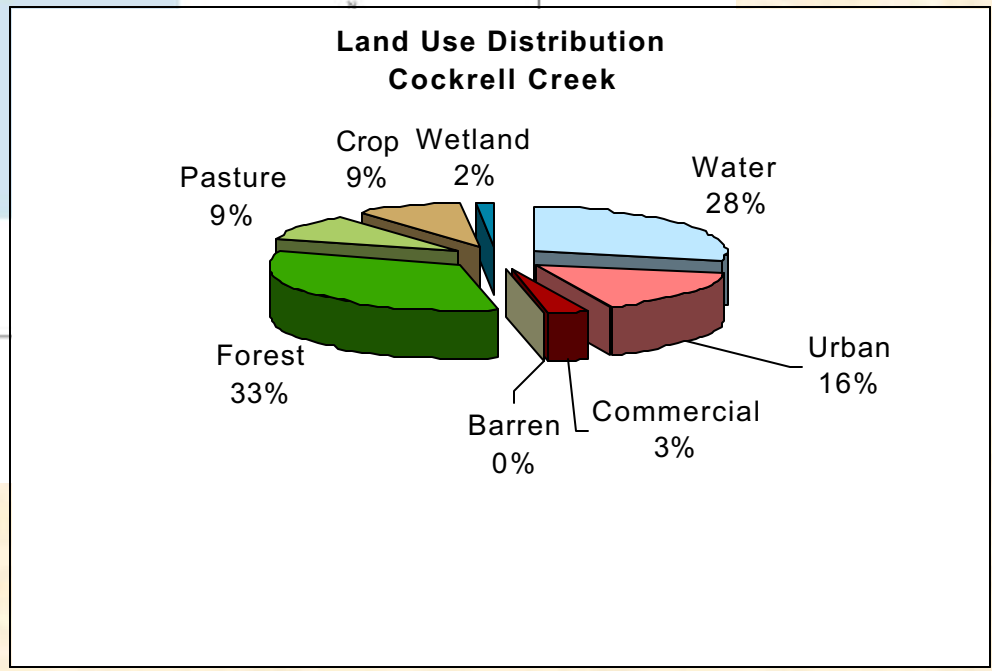

Cockrell Creek
Land Use/Land Cover
Water
Urban
Commercial
Barren
Forest
Pasture
Crop
Wetland
Data Source: National Land Cover Data Set, U.S. Geological Survey, 1999
Digital Line Graphs, U.S. Geological Survey, 1999
Map Date: June, 2004

Figure 3.1


Land Use Distribution
Cockrell Creek
Crop 9%
Wetland 2%
Pasture 9%
Water 28%
Forest 33%
Urban 16%
Barren 0%
Commercial 3%

## Table 3-1 Animal Populations and Septic Systems Growing Area 12

| Fecal Coliform Sources | 2 Cockrell Creek |
|---|---|
| Cattle | 21* |
| Horse | 6* |
| Pig | 0 |
| Deer | 38 |
| Duck | 485 |
| Geese | 334 |
| Raccoon | 85 |
| Dog | 55 |
| Estimated Septic Systems | 90 |

* - from DSS Shoreline survey 2004.

Estimated Human population = 392. (2000 U.S. Census)

Approx. 60% of urban area with public sewer. (Analyzed via GIS data from NNPDC.)

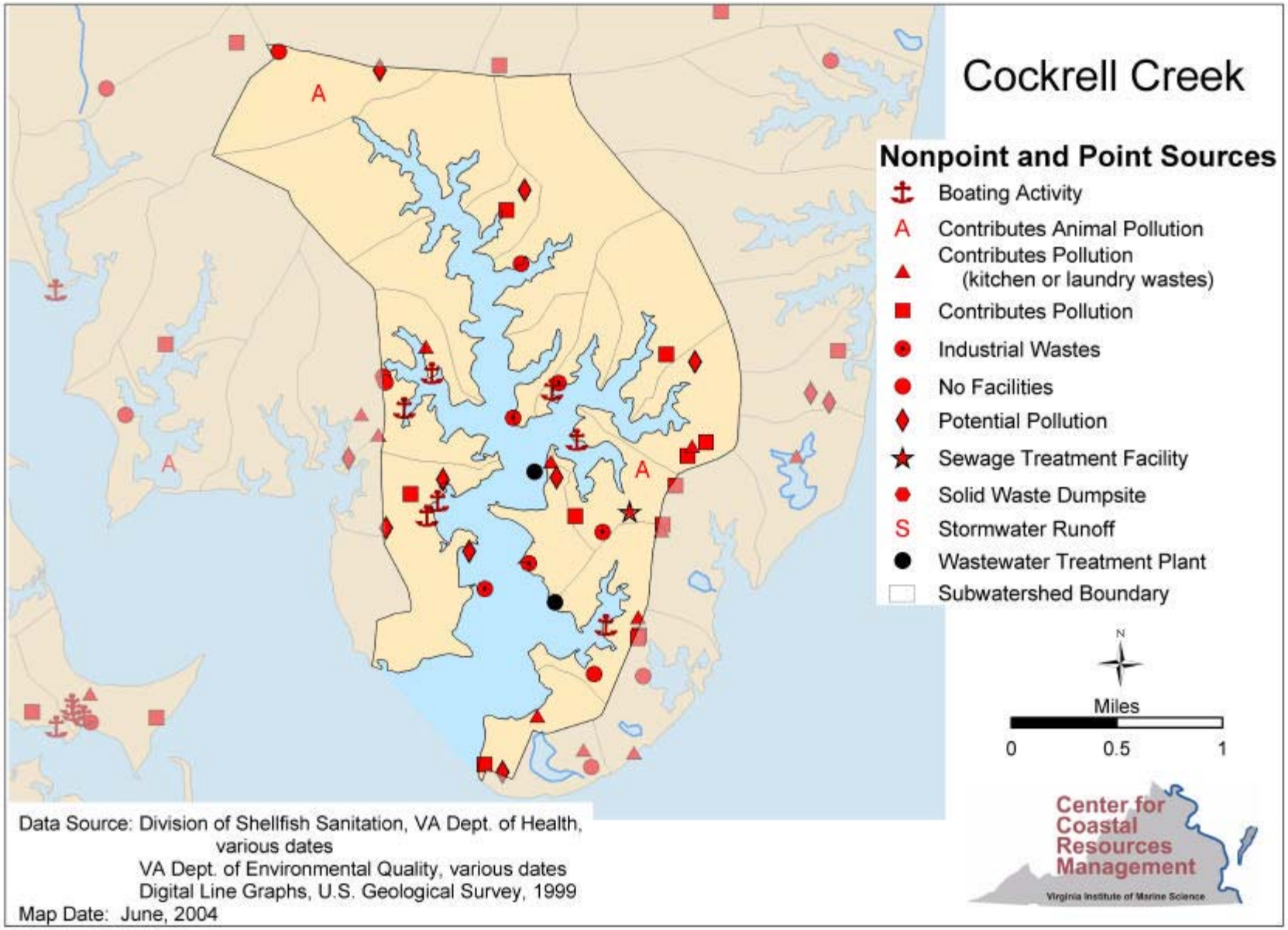

Cockrell Creek
Nonpoint and Point Sources
Boating Activity
A Contributes Animal Pollution
Contributes Pollution (kitchen or laundry wastes)
Contributes Pollution
Industrial Wastes
No Facilities
Potential Pollution
Sewage Treatment Facility
Solid Waste Dumpsite
S Stormwater Runoff
Wastewater Treatment Plant
Subwatershed Boundary
N
Miles
0
0.5
1
Center for Coastal Resources Management
Virginia Institute of Marine Science
Data Source: Division of Shellfish Sanitation, VA Dept. of Health, various dates
VA Dept. of Environmental Quality, various dates
Digital Line Graphs, U.S. Geological Survey, 1999
Map Date: June, 2004

Figure 4.4

# Water Quality Monitoring & Data

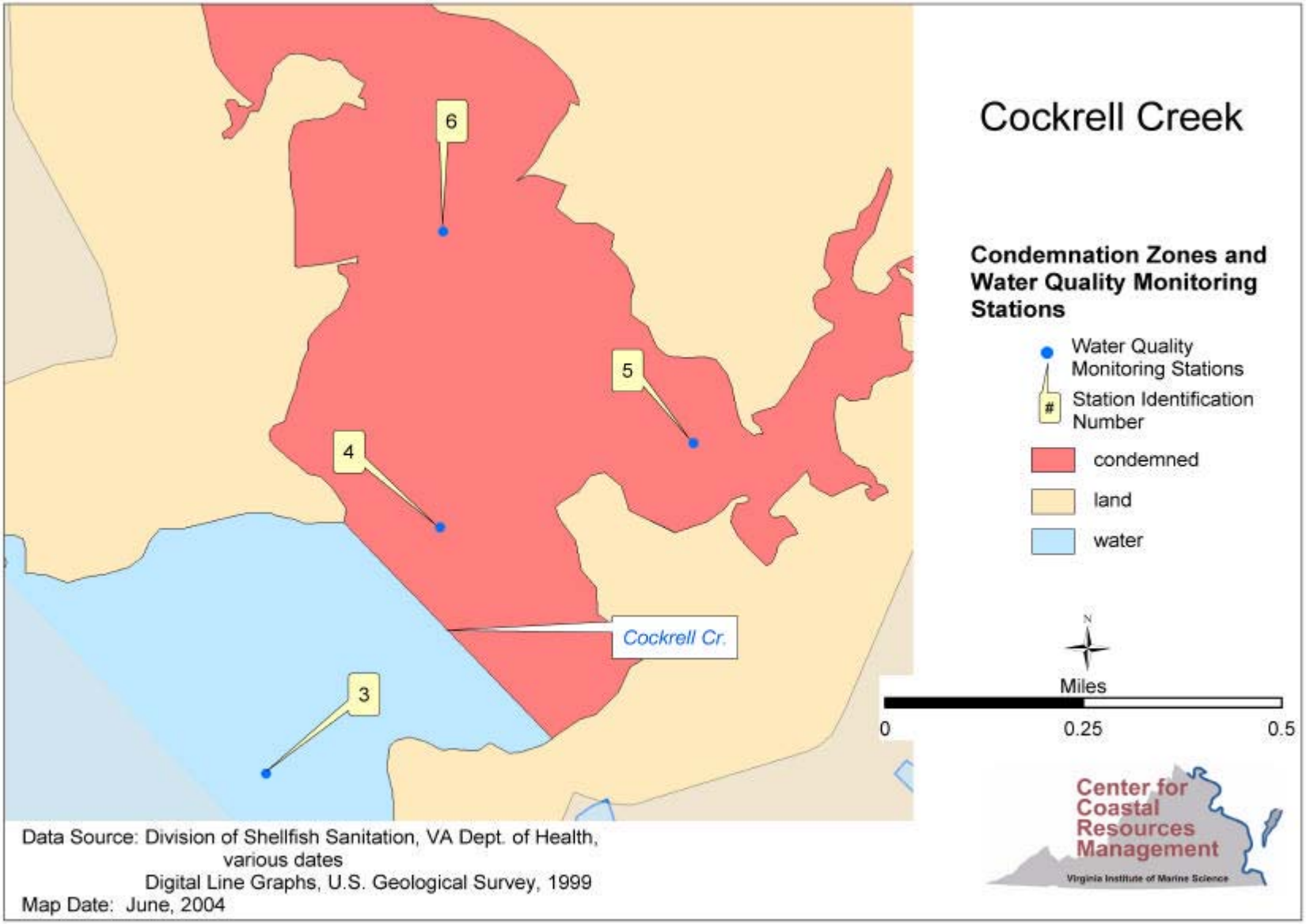
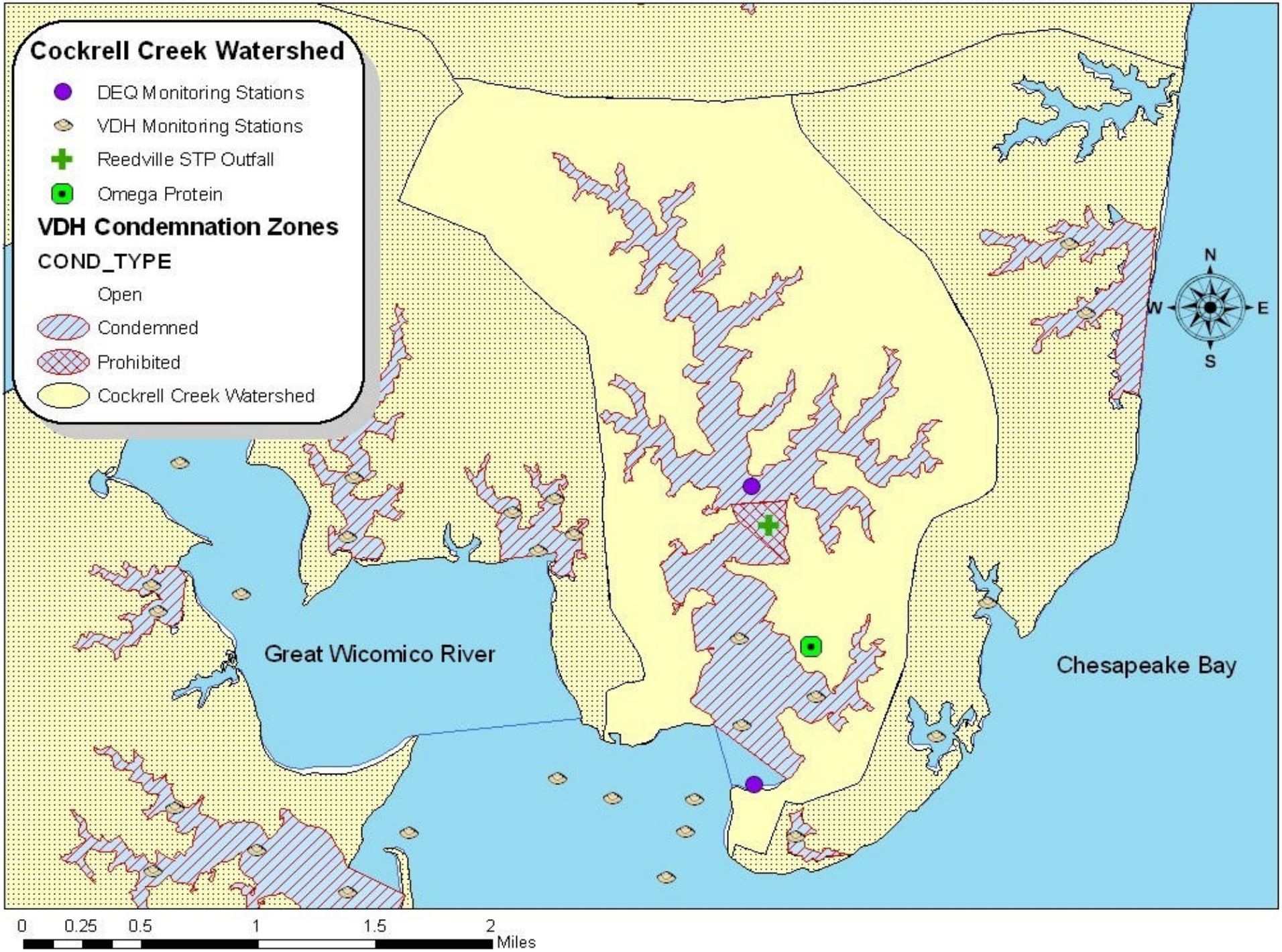
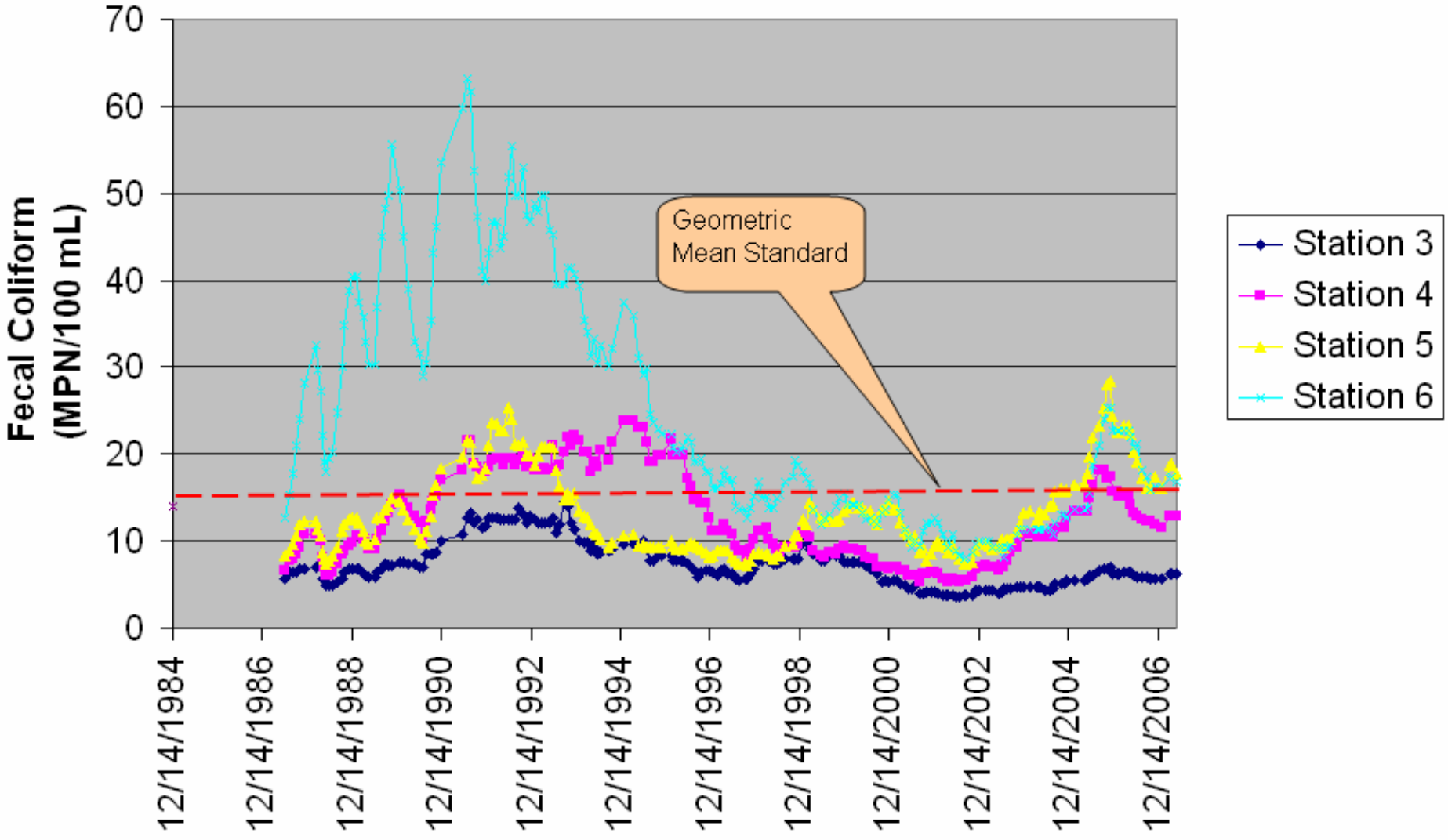
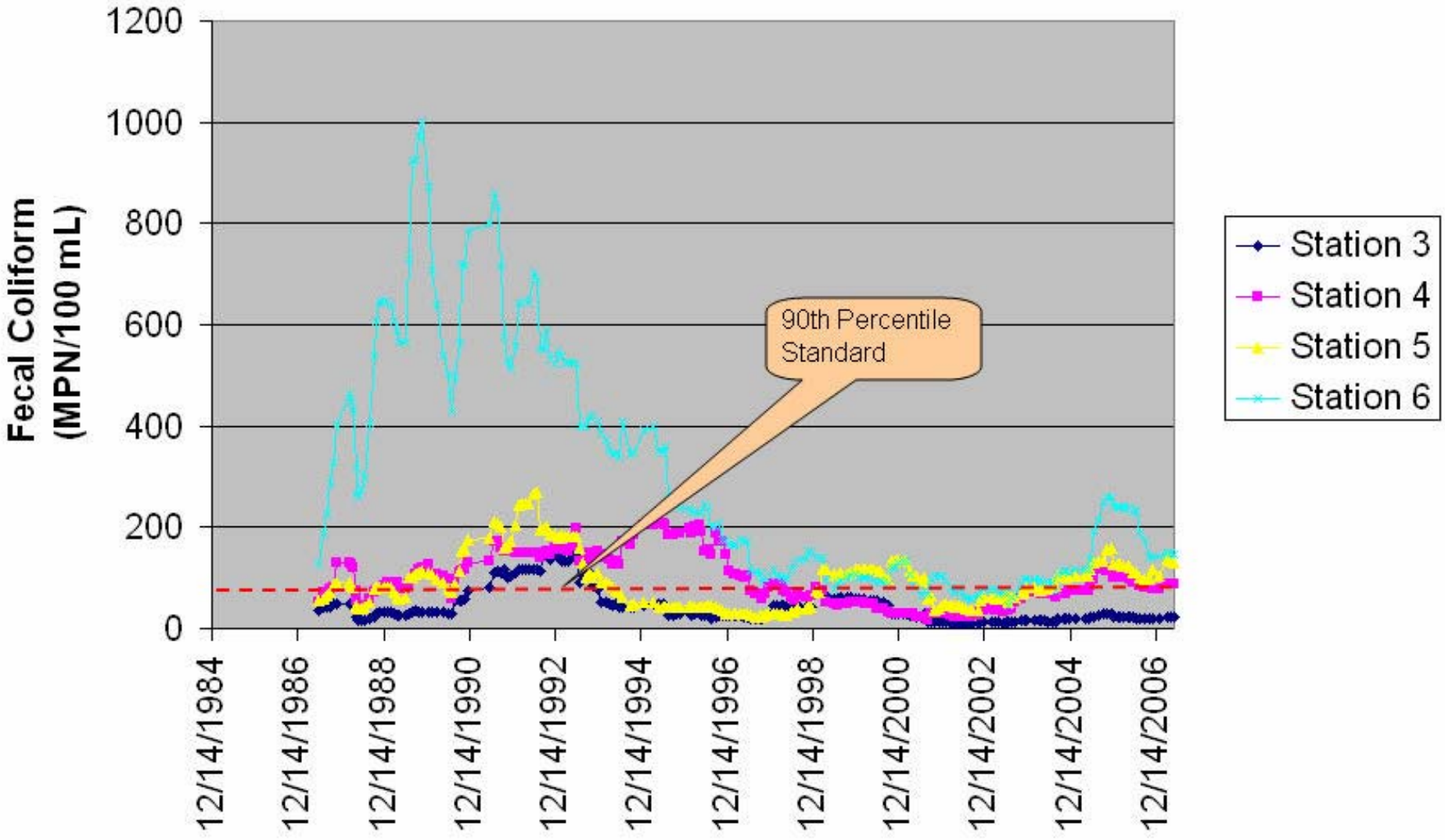

Cockrell Creek
Condemnation Zones and Water Quality Monitoring Stations
Water Quality Monitoring Stations
# Station Identification Number
condemned
land
water
6
5
4
3
Cockrell Cr.
N
Miles
0
0.25
0.5
Center for Coastal Resources Management
Virginia Institute of Marine Science
Data Source: Division of Shellfish Sanitation, VA Dept. of Health, various dates
Digital Line Graphs, U.S. Geological Survey, 1999
Map Date: June, 2004

Figure 4.1

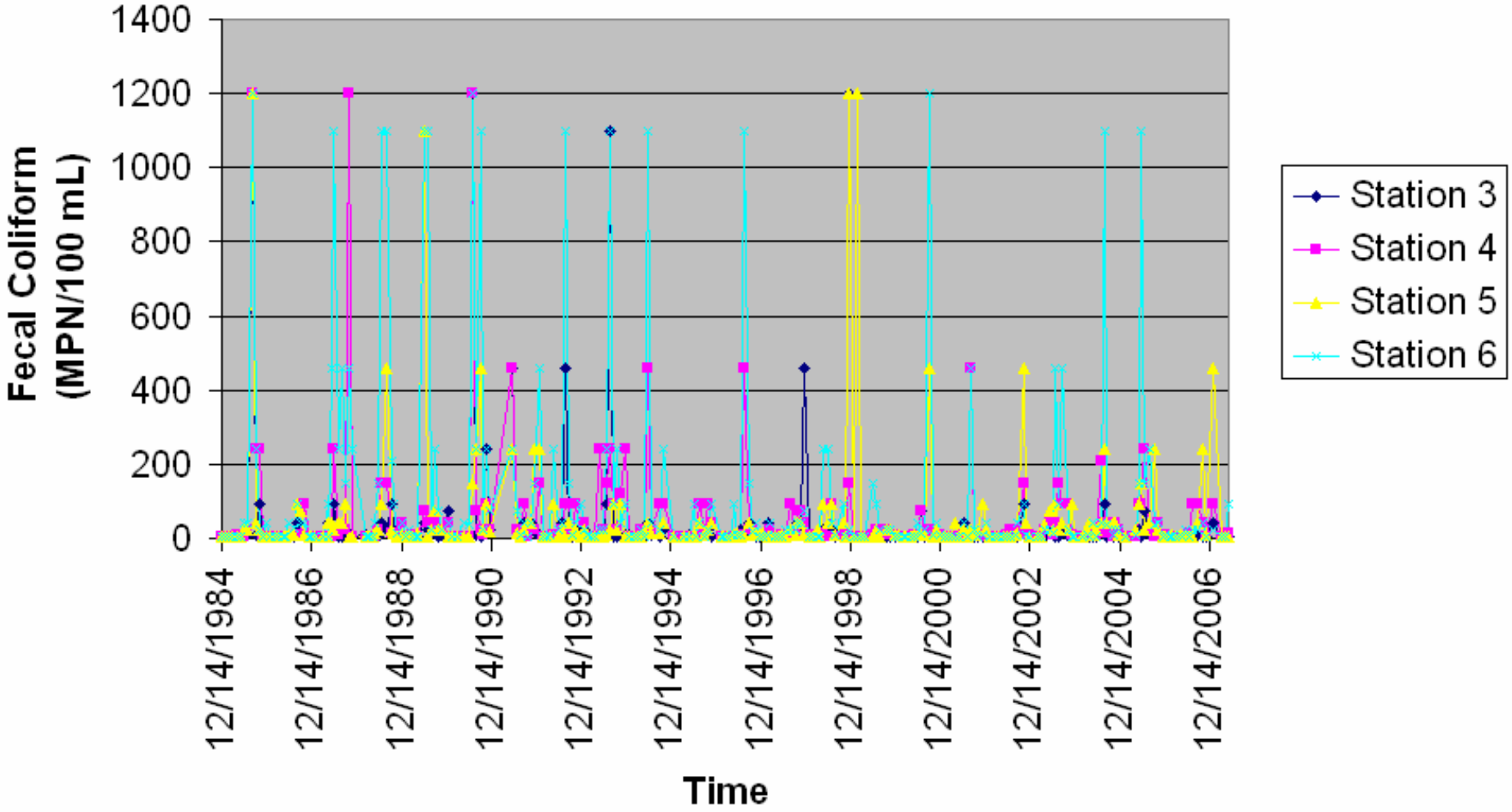

Cockrell Creek Watershed
DEQ Monitoring Stations
VDH Monitoring Stations
Reedville STP Outfall
Omega Protein
VDH Condemnation Zones
COND_TYPE
Open
Condemned
Prohibited
Cockrell Creek Watershed
N
W
E
S
Great Wicomico River
Chesapeake Bay
0
0.25
0.5
1
1.5
2
Miles

# DEQ 2006-2007 Special Study Monitoring Stations

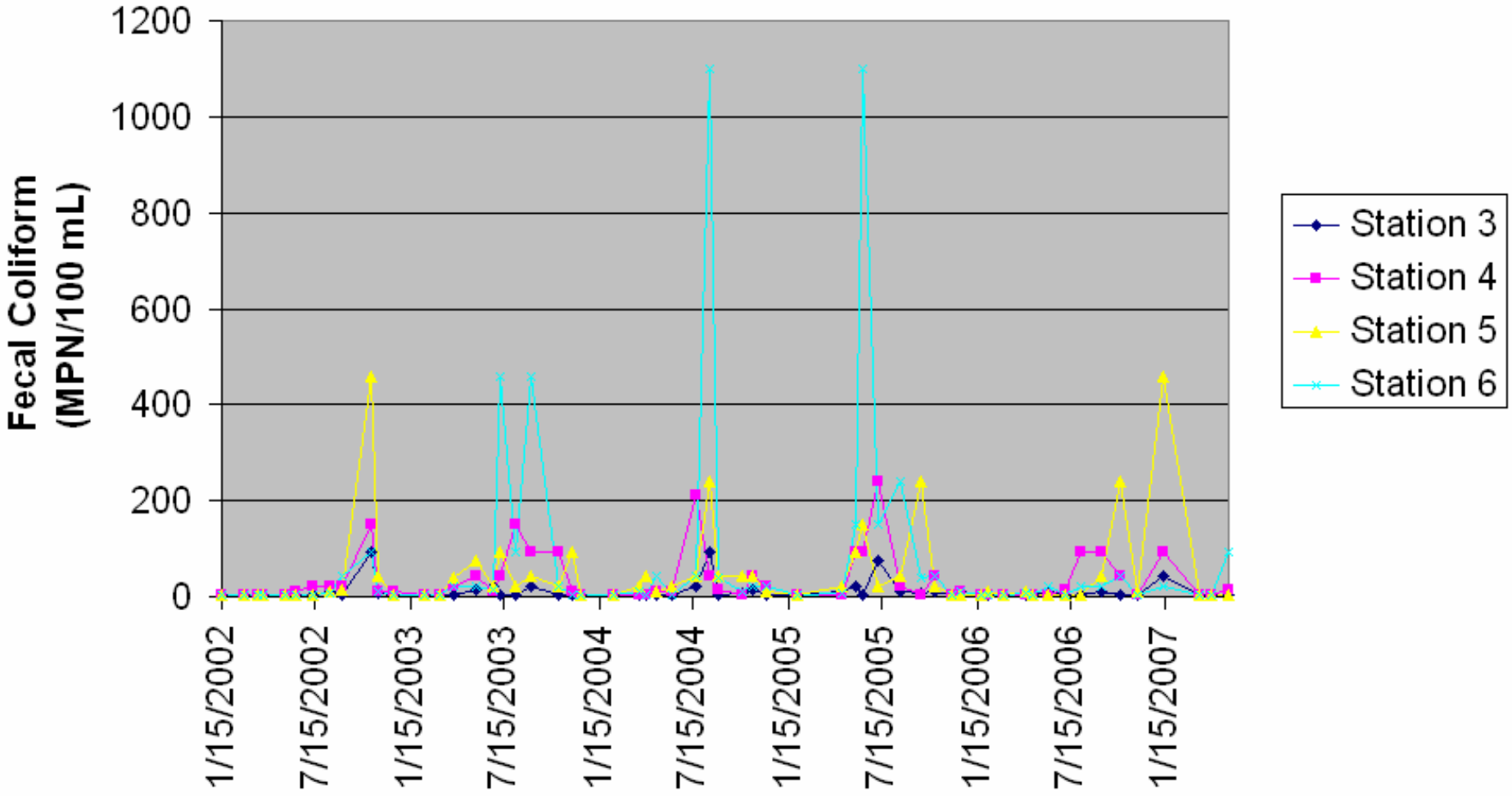

Cockrell Creek - Running Geometric Mean
Fecal Coliform (MPN/100 mL)
70
60
50
40
30
20
10
0
12/14/1984
12/14/1986
12/14/1988
12/14/1990
12/14/1992
12/14/1994
12/14/1996
12/14/1998
12/14/2000
12/14/2002
12/14/2004
12/14/2006
Geometric Mean Standard
Station 3
Station 4
Station 5
Station 6

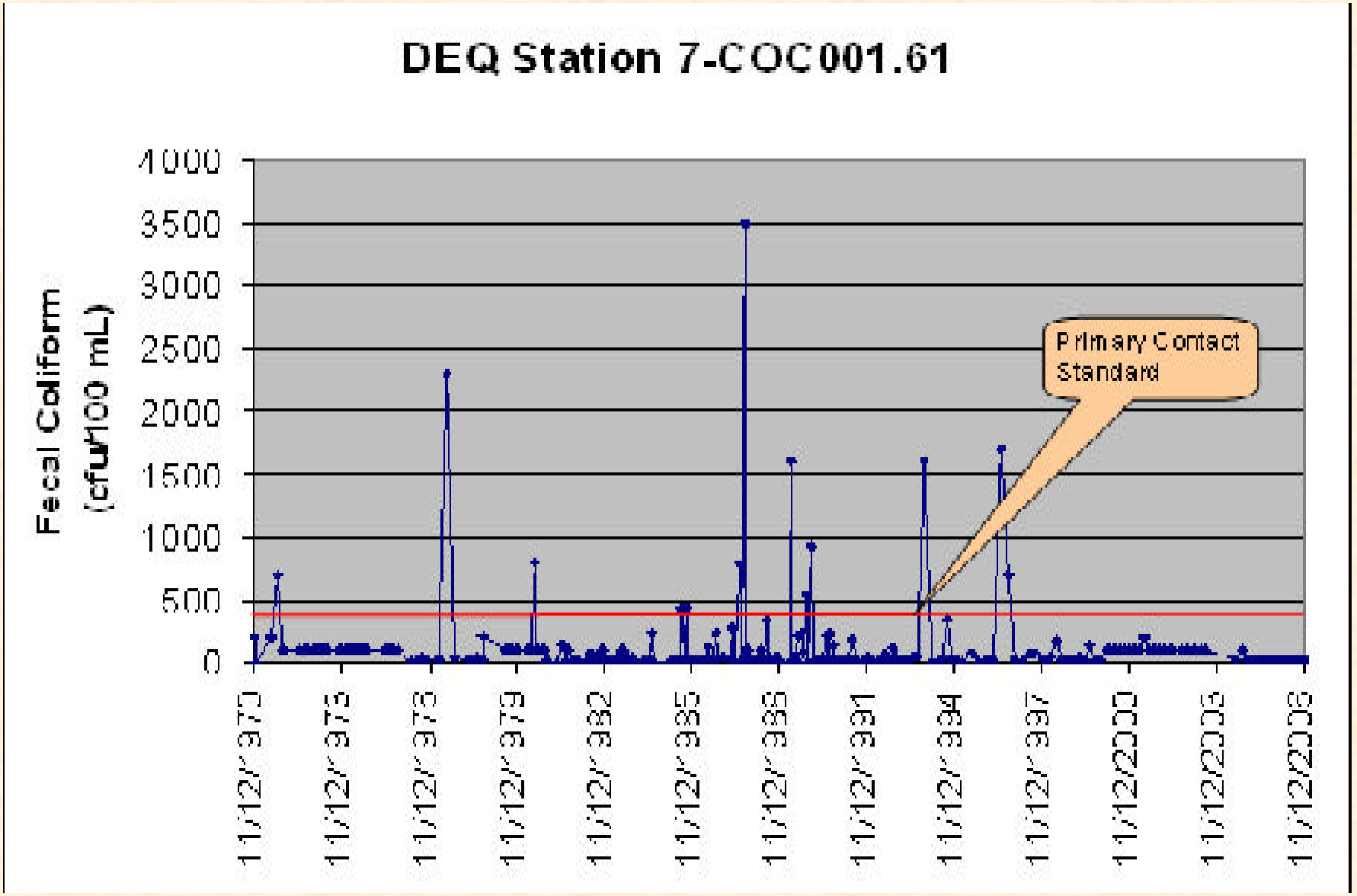

Cockrell Creek - Running 90th Percentile
Fecal Coliform (MPN/100 mL)
1200
1000
800
600
400
200
0
12/14/1984
12/14/1986
12/14/1988
12/14/1990
12/14/1992
12/14/1994
12/14/1996
12/14/1998
12/14/2000
12/14/2002
12/14/2004
12/14/2006
90th Percentile Standard
Station 3
Station 4
Station 5
Station 6

# VDH Bacterial Data (Cockrell Creek)
# 1984-Present



# VDH Bacteria Data (Cockrell Creek)
# 2002 - Present




DEQ Station 7-COC001.61
Fecal Coliform (cfu/100 mL)
4000
3500
3000
2500
2000
1500
1000
500
0
Primary Contact Standard
11/12/1971
11/12/1973
11/12/1975
11/12/1979
11/12/1982
11/12/1985
11/12/1988
11/12/1991
11/12/1994
11/12/1997
11/12/2000
11/12/2003
11/12/2006

# DEQ Special Study - Fecal coliform Results

| Monitoring Station | Station Description | 3-Aug-06 | 20-Sept-06 | 27-Sept-06 | 22-Feb-07 |
|---|---|---|---|---|---|
| 7-COC000.86 | VDH-DSS Site 12-6 | **25** | <100 U | **1000** | <10 U |
| 7-COC000.88 | SE Corner Omega Pier with Ships | **>2000 L** | **1600** | <100 U | <10 U |
| 7-COC000.89 | South Side Omega Pier with Ships | **520** | **1000** | **1000** | <10 U |
| 7-COC000.92 | West Side Omega Pier with Ships | **>2000 L** | **400** | **1000** | <10 U |
| 7-COC000.95 | North Side Omega Pier with Ships | N/A | **1700** | **200** | <10 U |
| 7-XAN000.17 | VDH-DSS Site 12-5 | <25 U | <100 U | **4000** | <10 U |
| VA0003867-002 | Omega Outfall 002 | **280** | **>8000 L** | **5000** | <10 U |
| VA0003867-995 | Omega Outfall 995 | **>2000 L** | **10,000** | **1400** | N/A |
| VA0003867-INT | Omega Water Intake | **780** | **1800** | **500** | <10 U |

Fecal Coliform Units = # cfu/100 mL

**Bold & Red Bacteria Values** = WQ Violations using instantaneous primary contact standard 400 cfu/100mL (fecal coliform)
**Bold Bacteria Values** = WQ Violations using 90th Percentile shellfish standard - 49 MPN/100mL (fecal coliform)
Com Code L = Off Scale high, actual value greater than the value shown (>max detection limit)
Com Code U = Material analyzed for but not detected (<minimum detection limit)
NA = Not Available

# DEQ Special Study – Enterococci Results

| Monitoring Station | Station Description | 3-Aug-06 | 20-Sept-06 | 27-Sept-06 | 22-Feb-07 |
|---|---|---|---|---|---|
| 7-COC000.86 | VDH-DSS Site 12-6 | 75 | **110** | **210** | <25 U |
| 7-COC000.88 | SE Corner Omega Pier with Ships | **1800** | **3400** | **680** | <25 U |
| 7-COC000.89 | South Side Omega Pier with Ships | **680** | **600** | **240** | <25 U |
| 7-COC000.92 | West Side Omega Pier with Ships | **>2000 L** | **300** | **520** | <25 U |
| 7-COC000.95 | North Side Omega Pier with Ships | N/A | **800** | **1000** | <25 U |
| 7-XAN000.17 | VDH-DSS Site 12-5 | <25 U | <10 U | <10 U | <25 U |
| VA0003867-002 | Omega Outfall 002 | **300** | **160** | **700** | <25 U |
| VA0003867-995 | Omega Outfall 995 | **>2000 L** | **4600** | **1400** | N/A |
| VA0003867-INT | Omega Water Intake | **>2000 L** | **>8000 L** | **>8000 L** | <25 U |
| 7-COC001.61 | DEQ Ambient Station | N/A | N/A | N/A | 25 |
| 7-COC000.27 | DEQ Ambient Station | N/A | N/A | N/A | 75 |

Enterococci Units = # cfu/100 mL

**Bold & Red Bacteria Values** = WQ Violations using instantaneous primary contact standard 104 cfu/100mL (Enterococci)

Com Code L = Off Scale high, actual value greater than the value shown (>max detection limit)

Com Code U = Material analyzed for but not detected (<minimum detection limit)

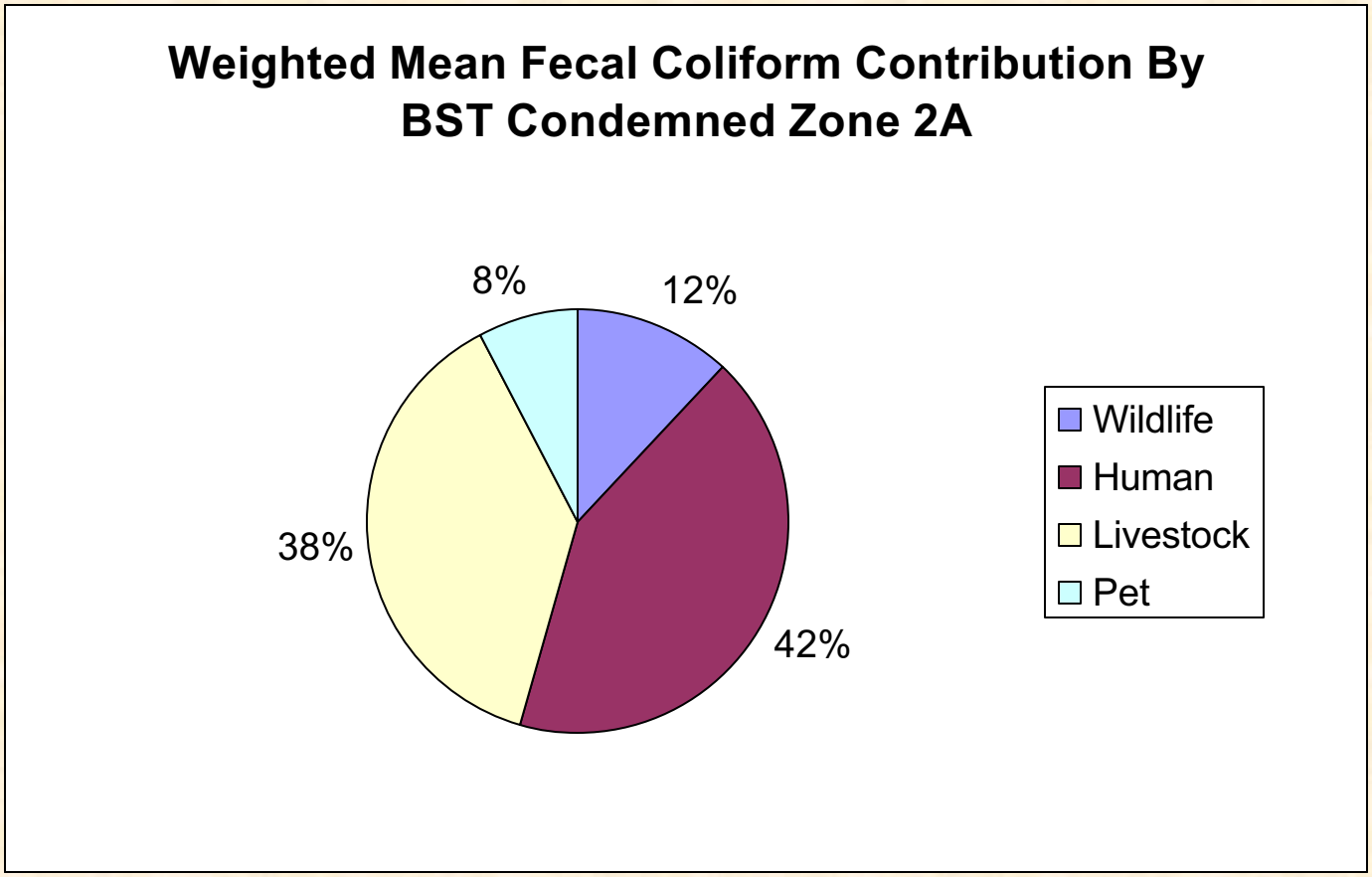
NA = Not Available

# ***Use of BST in the TMDL***

- Uses VDH-DSS routine monitoring data to calculate critical fecal count
- Uses 9 supplementary BST samples at selected stations to identify bacteria sources:
- Uses Antibiotic Resistance Analysis

  as BST method for source load allocation into 4 categories:

1. **Human**
2. **Pets**
3. **Livestock**
4. **Wildlife**




DEQ Special Study – BST Utilized.

- Significant Human Signature Detected in Omega Protein Intake & Discharges

# Water Quality Data Summary

- DEQ station 7-COC001.61 shows long term improvement, attributable to upgrades at the Reedville STP in the 1990's
- VDH-DSS data shows seasonal exceedances of the Shellfish Water Quality Standard
- BST Data shows a significant human source from Omega Protein
- DMR data collected by Omega continues to show high bacterial counts from the treatment lagoon
- BST data from Omega lagoon includes human signature

# Water Quality Data Summary

- Many bacterial samples from the Special Study not only exceed the Shellfish Standard, but also the Primary Contact (Swimming) Standard
- Omega DMR data also exceeds the Primary Contact (Swimming) Standard
  - Cockrell Creek will be listed as impaired for Primary Contact in 2008 VA Water Quality Assessment

# Additional Information to Support Study

- 2002 Fluorometric Dye Trace Study conducted for Omega Protein
  - Showed Omega vessels influence facility intake
- 2004 VDH-DSS Shoreline Survey
  - All Marinas have Pump-out facilities for boats
  - DEQ station 7-COC001.61 does not show high bacterial values
- 2006-2007 DEQ Special Study
  - Significant human bacterial sources at Omega Intake & discharges
  - No violations of water quality standards during Omega off season

# Conclusions

- Omega Protein, Inc. operational activities contribute significantly to the bacterial impairment in Cockrell Creek
- The Omega Fleet is the most probable source of bacteria
  - Ships have Type II Marine Sanitation Devices (MSDs) which discharge at 200 cfu/100mL (>14 times the shellfish standard)
- Omega Lagoon is a source of bacteria
    - DMR data, DEQ sampling, BST Human signature

# Conclusions

- Additional non-point sources of bacteria are found within the watershed
- All 4 categories detected with in-stream BST samples

# TMDL Calculation

# Shellfish Designated Use Load Reductions

**Table 5.1. Geometric Mean Analysis of Current Load and Estimated Load Reduction**

| Condemnation Area | Volume ($m^3$) | Fecal Coliform (MPN/100ml) | WQ Standard MPN/100 ml | Current Load (MPN/day) | Allowable Load (MPN/day) | Required Reduction (%) |
|---|---|---|---|---|---|---|
| 002A Cockrell Creek (VAP-C01E-08) | 5102820 | 37.4 | 14 | 1.91E+12 | 7.14E+11 | 63% |

**Table 5.2. $90^{th}$ Percentile Analysis of Current Load and Estimated Load Reduction**

| Condemnation Area | Volume ($m^3$) | Fecal Coliform (MPN/100ml) | WQ Standard MPN/100 ml | Current Load (MPN/day) | Allowable Load (MPN/day) | Required Reduction (%) |
|---|---|---|---|---|---|---|
| 002A Cockrell Creek (VAP-C01E-08) | 5102820 | 399.5 | 49 | 2.04E+13 | 2.50E+12 | 88% |

# Shellfish TMDL

**Reduction and Load Allocation Based Upon 90th Percentile Standard: Cockrell Creek - Growing Area 12**

| Condemnation Area | Source | BST Allocation % of Total Load | Current Load MPN/ day | Load Allocation MPN/ day | Reduction Needed |
|---|---|---|---|---|---|
| 002A Cockrell Creek (VAP-C01E-08) | Wildlife | 12% | 1.60E+12 | 1.60E+12 | 0% |
| | Human | 42% | 5.59E+12 | 0.00E+00 | 100% |
| | Livestock | 38% | 5.06E+12 | 0.00E+00 | 100% |
| | Pets | 8% | 1.06E+12 | 8.90E+11 | 16% |
| | **Total** | **100%** | **2.04E+13** | **2.50E+12** | **88%** |

**Reduction and Waste Load Allocation Based Upon 90th Percentile Standard: Cockrell Creek - Growing Area 12**

| Condemnation Area | Discharger | Current Load MPN/ day | Load Allocation MPN/ day | Reduction Needed |
|---|---|---|---|---|
| 002A Cockrell Creek (VAP-C01E-08) | Omega Protein (VA0003867) | 7.09E+12 | 9.97E+09 | 100% |

# Primary Contact Designated Use TMDL

**Table 5.3 Calculations for Recreation Use Impairments in Cockrell Creek**

| Impaired Area | Volume ($m^3$) | Bacteria Pollutant | Current Load (cfu/day) | Allowable Load (cfu/day) | Required Reduction (%) |
|---|---|---|---|---|---|
| 002A Cockrell Creek (VAP-C01E-08 | 5102820 | *Enterococci* | 4.08E+14 | 5.31E+12 | 99% |

Highest observed ambient exceedence = >8000 cfu at Omega Protein, Inc.

# TMDL Summary

**Table 5.8. TMDL Summary for the Closure in the Cockrell Creek Watershed ($90^{th}$ percentile)**

| Condemnation Area | Pollutant Identified | TMDL MPN/day | Waste Load Allocation MPN/day | Load Allocation MPN/day | Margin of Safety |
|---|---|---|---|---|---|
| 002A Cockrell Creek (VAP-C01E-08) | Fecal Coliform | 2.50E+12 | 9.97 E+09 | 2.50E+12 | Implicit |

**TMDL Summary for the Recreation Use Impairment in Cockrell Creek**

| Impaired Water body Segment | Volume ($m^3$) | Bacteria Pollutant | Load Allocation (cfu/day) | Wasteload Allocation (cfu/day) | TMDL | Margin of Safety |
|---|---|---|---|---|---|---|
| 002A Cockrell Creek | 5102820 | *Enterococci* | 5.29E+12 | 2.49E+10 | 5.31E+12 | Implicit |

# Some Suggested Implementation Measures

- Establish No discharge Zone for vessels in Cockrell Creek or Great Wicomico River and tributaries
- More vigorous policing of pump out requirements
- Require higher level of septic treatment in home systems that need replacement and for new homes
- Establish a state cost share/grant program to aid home owners in replacing failing or inadequate systems
- Public education effort regarding animal and pet waste
- Public education effort regarding proper septic tank maintenance

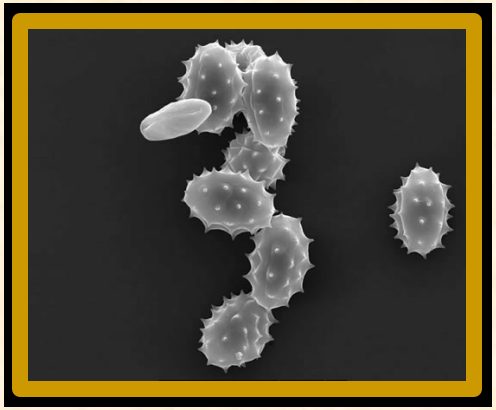
# Water Quality Fact

- "A single weekend boater flushing untreated sewage into our waters produces the same amount of bacterial pollution as 10,000 people whose sewage passes through a treatment plant."

  - California Department of Boating and Waterways

# Water Quality Fact

- " A single overboard discharge of human waste can be detected in up to a one square mile area of shallow enclosed water. Contaminants known from human waste include hepatitis, streptococci, fecal coliform and other bacteria."



  - Florida Department of Environmental Protection

# Current No Discharge Zones (NDZs) in VA

- Smith Mountain Lake
- VA Beach Area (Lynnhavan, Broad, & Linkhorn Bays)

- VA Beach Area – Current efforts to establish additional NDZs for entire jurisdiction

- NDZs – possibly the most cost effective BMP to restore local water quality

# *Next steps*

- 30 Day Public Comment Begins
- TMDL will be presented at SWCB meeting
- TMDL will be sent to EPA for approval

Send written comments to:

Mark Alling
4949-A Cox Rd
Glen Allen VA 23060
804/527-5021
msalling@deq.virginia.gov

# Omega Protein WLA by Outfall

**Table 5.4. Omega Protein, Inc. Fecal Coliform Wasteload Allocation**

| Omega Protein Outfall | Daily Maximum Design Flow (MGD) | Highest recorded fecal coliform (cfu/100 mL) | Fecal Coliform Existing load | Fecal Coliform Wasteload Allocation |
|---|---|---|---|---|
| 001 | 4.14 | 10,000* | 1.57E+12 | 2.19E+09 |
| 002 | 0.481 | >8000 | 1.46E+11 | 2.55E+08 |
| 995 | 14.2 | 10,000 | 5.37E+12 | 7.52E+09 |
| | | Total | 7.09E+12 | 9.97E+09 |

* Bacterial samples not collected at 001 during study. Since source water for 995 & 001 are same, values for 995 were assigned to 001.

**Table 5.5. Omega Protein, Inc. Enterococci Wasteload Allocation**

| Omega Protein Outfall | Daily Maximum Design Flow (MGD) | Highest recorded Enterococci (cfu/100 mL) | Enterococci Existing Loads | Enterococci Wasteload Allocation |
|---|---|---|---|---|
| 001 | 4.14 | 4600* | 7.21E+11 | 5.48E+09 |
| 002 | 0.481 | 700 | 1.27E+10 | 6.37E+08 |
| 995 | 14.2 | 4600 | 2.47E+12 | 1.88E+10 |
| | | Total | 3.21E+12 | 2.49E+10 |

* Bacterial samples not collected at 001 during study. Since source water for 995 & 001 are same, values for 995 were assigned to 001.